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陕西府谷晚中新世 *Acerorhinus* 属(奇蹄目，犀科)一新种[1)]

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摘要 记述的 *Acerorhinus fuguensis* sp. nov. 是 *Acerorhinus* 属中一个相当进步的种。府谷保存完整的标本使我们对 *Acerorhinus* 的特征有了更全面且准确的认识。新种以强烈外展的鼓后突和头骨顶面在眶前的骤然收缩区别于塞瓦斯托波尔的 *A. zernowi* 和柴达木的 *A. tsaidamensis*。新种下门齿内刃上翻的特点显示 *Acerorhinus* 属有向 *Chilotherium* 属演化的趋势。

关键词 陕西府谷，晚中新世，犀科

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府谷含大唇犀类化石的地点老高川王大夫梁位于县城西北约 60km 处。在该地区中生代含煤岩系之上，发育有厚约 52m 的晚第三纪地层，其上黄土层覆盖。该上第三系按岩性可划分为 3 段：下段为黄灰、黄红色砂质粘土，厚 23.5m，其中的钙质富集层呈灰白色，在喇嘛沟的本层段下部产有丰富的化石；中段为红褐色砂质粘土，钙质结核明显成层状分布，厚 16.5m；在喇嘛沟背面的庙梁剖面中段中、上部含较为丰富的化石；上段为棕红、红褐色砂质粘土，钙质结核颇多，但成层性不明显，厚约 12m。Xue *et al.* (1995) 根据化石组合及古地磁测定，确定府谷老高川剖面下、中段的地质时代属晚中新世晚期，年龄为 7.4～5.3Ma B.P.，而上段属上新世。

本文将描述和讨论产自老高川剖面下、中段晚中新世晚期地层的 *Acerorhinus* 属一新种。标本保存于中国科学院古脊椎动物与古人类研究所。

1 系统描述

Family Rhinocerotidae Owen, 1845

Subfamily Aceratheriinae Dollo, 1885

Tribe Chilotherini Qiu, Xie et Yan, 1987

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Genus *Acerorhinus* Kretzoi, 1942

Acerorhinus fuguensis sp. nov.

(图版 Ⅰ～Ⅱ；表 1～5)

正型 V 11963，头骨，成年个体。

其他标本 V 11964，头骨，成年个体，左侧残破，标本因受挤压而略变形，整个标本向右侧斜歪；V 11965，头骨，成年个体；V 11966，下颌骨，保存较好，仅下颌联合部的右半部和两侧上升枝的上半部断失，牙齿磨蚀程度中等，系一成年雌性；V 11967，左下颌骨，上升枝破损。

名称来源 Fugu，府谷，化石产地的行政区名。

产地与时代 陕西省府谷县老高川王大夫梁；晚中新世晚期。

特征 个体大。鼓后突扁薄，横向展伸，向下低于枕髁。假外耳道下方不封闭或封闭弱。鼻颌切迹深达 M1 前缘水平。矢状嵴窄而高耸。眼眶位置低，眶上突成结节状，厚实而突起强烈。眶后突弱。头骨顶面在眶前骤然收缩。眶前窝发达。上前臼齿磨蚀较深时中谷封闭形成中窝，原尖和次尖的收缩弱。上臼齿外壁不平直，前附尖褶和前尖肋发达。前臼齿和 M3 都没有或几乎没有反前刺。下颌联合部窄，宽度小于 p2 间距离。i2 内刃略上翻。

描述 头骨：枕大孔上缘与枕髁的上缘在同一水平或略高，枕孔的形状呈钟形。枕面的下半部很宽，上半部窄。乳突在枕面上出露的面积较大，向下延伸形成鼓后突，其下缘远低于枕髁的下缘水平。乳突的后面很粗糙，比枕面更靠前。副枕突自枕面看相当细弱，中央收缩，位于乳突内侧。自腹面看，副枕突呈三棱锥形，直或稍微向前弯曲。自侧面看，乳突及其向下延伸形成的鼓后突呈薄片状，明显前倾。鼓后突末端超过关节后突 1/2 处，二者相当贴近或轻度愈合以至形成封闭的假外耳道。自侧面看，副枕突与乳突在同一平面上，而鼓后突位于该平面前方，副枕突与关节后突平行或呈一定角度。枕嵴圆滑，中央呈 V 形的深沟。项韧带窝深，整个枕面都相当粗糙。鼓后突后表面的外边缘有一系列横向的棱嵴。关节后突极其强大，其前表面为一弯曲的三角形凹面。颞髁细长，内侧以一弧形弯曲与关节后突的前表面联结，在 V 11964 上，这一联结的弯曲面非常宽大。颞髁后的关节面较小，其后边缘呈隆起的宽嵴状。从腹面看，枕髁间切迹宽阔。

颧弓前端达 M2 前缘水平，颧弓最宽处约在M2/M3 界线水平，向后逐渐变窄，最窄处在颞髁前部水平，向后又逐渐增宽，其后上角延伸远，强烈突出，使颧弓后缘斜向前下方。整个颧弓呈薄片状。眼眶小，位置低，其上缘低于额平面约 30mm。额骨上无明显的眶后突，而在眼眶上缘有一非常发达的结节，即眶上突，此处为头骨顶面最宽处，结节后方有一显著的切迹。颧骨上也几乎没有眶后突。眼眶前缘位于 M2 中线水平，眶前窝深。眼眶前边缘圆而显得异常突出，接近眼眶前上角有一小的泪结节。

上颌骨表面与齿根对应位置都发育粗壮的隆起。上颌骨颜面部有 3 个大的眶下孔 (V 11963, V 11964)，都距鼻颌切迹下缘较近。后面的两个眶下孔毗邻，位于鼻颌切迹底部水平，中间以嵴相隔，其中前下方的一个有前导沟；另一个单独的眶下孔位于鼻颌切迹中部位置，也有明显的前导沟。上颌骨上缘 (鼻颌切迹下缘) 有一个大的眶下孔 (V 11964)，在水平方向上有延伸较远的前导沟。在上颌骨上缘边上还有一个很小的眶下孔。V 11965 上颌骨颜面部仅有一个较大的眶下孔，位于鼻颌切迹底部水平，其上颌骨上缘也

仅有一个小的眶下孔，这两个眶下孔都有前导沟。实际上，眶下孔的情况很不规则，表1是一些标本眶下孔的统计。

表1　*Acerorhinus fuguensis* sp. nov. 的眶下孔统计

Table 1　Infraorbital foramina of *Acerorhinus fuguensis* sp. nov.

位置 position	V 11963	V 11964	V 11965
上颌骨颜面部 maxillary face	3	3	1
上颌骨上缘 maxillary upper margin	—	2	1

前颌骨的宽度比上颌骨前端窄得多，其前部为垂向的薄板状。鼻颌切迹深，眼眶前缘至鼻颌切迹后缘间的距离短。自侧面看，鼻颌切迹和它下方的上颌骨都较高。未发现有保留鼻骨末端的成年标本。从保存下来的接近端部的鼻骨看，未见有粗糙面存在。鼻骨基部非常宽大，两侧显著下垂，横断面透镜状。从鼻骨前端延伸的趋势看，鼻骨应比较长。

头骨顶面平，枕部上翘，额骨与鼻骨联结处有一宽浅的凹陷区，中央轻微凸隆。由于枕部位置较高，因此在头骨后部形成一个向前的斜面。整个头骨顶面呈窄长的菱形，在眼

表2　*Acerorhinus fuguensis* sp. nov.的头骨测量

Table 2　Measurements of skull of *Acerorhinus fuguensis* sp. nov.　　(mm)

测量项　measures	V 11963	V 11964	V 11965
1 枕髁至前颌骨距离 distance between occipital condyle and premaxillary bone	585	—	—
5 脑颅最小宽度 minimal width of braincase	88	—	82
6 枕嵴至眶后突距离 distance between occipital crest and postorbital process	265	290	—
7 枕嵴至眶上突距离 distance between occipital crest and supraorbital process	290	300	—
8 枕嵴至泪结节距离 distance between occipital crest and lacrimal tubercle	328	337	—
9 鼻切迹至眼眶距离 distance between nasal notch and orbit	95	88	95.5
13 枕髁至M3距离 distance between occipital condyle and M3	270	275	259
15 枕嵴宽度 width of occipital crest	162	—	—
16 乳突间宽度 width between mastoid processes	216	—	220
17 顶嵴间最小宽度 minimal width between parietal crests	28	48	—
18 眶后突间宽度 width between postorbital processes	165	—	192
19 眶上突间宽度 width between supraorbital processes	183	—	207
20 泪结节间宽度 width between lacrimal tubercles	178	—	208
21 颧弓间最大宽度 maximal width between zygomatic arches	267	—	288
22 鼻骨基部宽度 width of nasal base	84	—	~72
23 枕面高度 height of occipital face	140	~153	—
25 P2 前头骨高度 height of skull in front of P2	~113	~109	—
26 M1前头骨高度 height of skull in front of M1	146	~130	148
27 M3 前头骨高度 height of skull in front of M3	146	~161	178
28 P2前腭宽 width of palate in front of P2	60	—	~74
29 M1前腭宽 width of palate in front of M1	86	—	86
30 M3前腭宽 width of palate in front of M3	89	—	76.5
31 枕大孔宽度 width of foramen magnum	45	45	45.5
32 枕髁间宽度 width between occipital condyles	118	~126.5	125

注：测量项编号和含义依据Guerin(1980)。

眶前面有骤然的收缩。顶嵴自眶后突向后，几乎呈直线伸向枕部，形成高耸的矢状嵴。顶嵴边缘向外突出成檐状(V 11964)。顶嵴两侧的脑颅外壁陡峻，脑颅相当狭窄。

腭骨的腭面较长，纵向深凹，沿中缝有一条细嵴，至硬腭后缘中央变为一个显著的结节。硬腭后缘呈尖锐的V形，但两侧边缘呈弧形，V字形的底部位于M2次尖水平。翼骨夹谷非常深。

头骨的测量数据见表2。

下颌骨：下颌水平枝从侧面看，其底缘在颊齿区微隆，从p2与p3的交界线水平显著地斜向前上方。颏孔位于p2正下方，靠近水平枝底缘，相当大，椭圆形，开口向前外方。下颌上升枝离m3相当远，其前缘形成宽大的曲面，曲面向上逐渐变宽，中央有纵向的凹沟。下颌角宽大，在边缘形成厚唇，肌肉附着的粗糙面显著。自顶面看，下颌联合部相当长而狭窄，其后缘约位于p3的中央水平。齿槽缘为薄锐的嵴形，在p2之前先向内收缩，再向外延伸至i2的远中缘。下颌联合部的顶面中凹相当深，其横断面呈宽大的V形深槽。自前面看，门齿齿槽缘平直，可能比较薄锐。下颌联合部腹面的凹陷不深。

门齿只保留i2，无其他门齿存在的痕迹。i2不是特别长大，伸向前外上方，其底部的断面近圆形，齿冠的断面呈刃在内侧的圆三角形。牙齿的磨蚀面在内上方，内刃略上翻。左右i2之间的夹角很小，相距很近。

下颌骨的测量数据见表3。

表3 *Acerorhinus fuguensis* sp. nov.的下颌骨测量

Table 3 Measurements of mandible of *Acerorhinus fuguensis* sp. nov. (mm)

测量项 measures	V 11966	V 11967
1 长度 length	522	—
2 下颌联合部至上升枝距离 distance between symphysis and ascending ramus	273	—
3 p3前下颌高度 height of jaw in front of p3	58	55.5
4 p4前下颌高度 height of jaw in front of p4	81	84
5 m1前下颌高度 height of jaw in front of m1	86.5	88
6 m2前下颌高度 height of jaw in front of m2	91	91
7 m3前下颌高度 height of jaw in front of m3	97.5	100
8 m3后下颌高度 height of jaw posterior to m3	98	101
11 下颌联合部长度 length of symphysis	138	—
13 上升枝前后径 anterior-posterior diameter	143	—

注：测量项编号和含义依据Guerin(1980)。

上颊齿：DP1单根，较大，整体形状呈圆三角柱形。未保存有齿冠的标本，因此冠面情况不详。

P2内侧齿带发育，只是在中谷出口处略降低。外壁圆隆，可见微弱的前附尖褶和前尖肋。原尖膨大，舌缘较平。次尖比原尖大，圆形。原脊和后脊唇端收缩。中谷不封闭，但在磨蚀程度较深的标本上，由于原尖和次尖的极度膨大，使其愈合造成中谷封闭，并在舌侧形成V形谷(V 11964)。前刺和小刺细小，有的具有2个前刺(V 11963)。前刺与同样细小的小刺连接形成中凹，V 11963因有2个前刺，因而形成2个小的中凹。前附尖末端平直，不向前突伸。后谷呈窄而深的V形，在磨蚀甚剧的标本上后谷接近封闭。原尖和次尖

都光滑无收缩。

P3与P2相似，但要大得多。原脊除原尖之外的部分窄，但并不形成明显的颈部。原尖与次尖大小接近。后脊上细弱的颈部仍然相当明显。前刺与小刺连结形成中凹。中谷未封闭，开口较大，但在磨蚀程度较深时封闭。前附尖褶和前尖肋明显。

P4的前附尖短圆或方形，前附尖褶和前尖肋显著。原尖和次尖依然膨大，原尖略大于次尖。原尖和次尖都光滑无收缩，但在磨蚀程度较深的标本上(V 11964)，其原尖具有微弱的后缢，因而形成一个宽大的反前刺，并向后伸展而接近次尖，几乎使中谷封闭。小刺和前刺粗强，联结形成封闭的中凹。后谷也封闭。齿带不完整，仅在原尖舌侧发育。

M1的前附尖宽短，前附尖褶和前尖肋发达。内侧齿带不发育，仅存在于中谷出口处。在磨蚀微弱的标本上(V 11963)，仅原尖膨大，且远大于次尖。而在磨蚀较深的标本上，次尖也膨大，以至原尖和次尖的尺寸近似(V 11964)。V 11963的原尖具有显著的后缢，有一个极短小的前刺对应褶，反前刺宽缓。V 11964的原尖舌缘平，收缢发达。次尖无后缢。前刺发达，呈粗棒状伸向前外方。小刺无或微弱，中谷口向牙冠根部方向变窄，以至中谷口接近封闭。后附尖宽大而外翘。后谷窄深。后尖褶宽缓但显著。V 11964的后谷口封闭。

M2的前附尖更小，前附尖褶和前尖肋发达，前凹显著。内侧齿带只有在中谷口可见残余，前齿带发育，后齿带只发育于后谷谷口。原尖从冠面向基部逐渐变大，收缢也由不显著到相当强烈。次尖稍膨大，后脊比原脊窄短。次尖的前缢无或微弱。前刺粗大，无小刺，反前刺也不明显。后谷口不封闭。后附尖长大，轻度磨蚀时末端尖锐，略向外翘，磨蚀较深时呈前窄后宽的梯形。

M3的牙齿轮廓呈三角形。前齿带非常发达，从舌侧向唇侧逐渐升高。内齿带仅发育于原尖舌侧，较强或相当显著，中谷口以后齿带缺失，有时在中谷内有一孤立突起的齿柱(V 11963的右M3)。前附尖尖锐。前附尖褶和前尖肋发达。原尖无前缢，后缢无或微弱。原脊窄长。前刺发达而细长，指向前内方。牙齿外缘后侧有一垂直棱，位于后缘齿带的外边缘，代表外脊与后脊的分界。中谷宽阔。

上颊齿的测量数据见表4。

表4　*Acerorhinus fuguensis* sp. nov.的上颊齿测量

Table 4 Measurements of upper cheek teeth of *Acerorhinus fuguensis* sp. nov.　　(mm)

测量项 measures	V 11963	V 11964	V 11965
DP1	—	23×21.7×7	—
P2	37×42×36.5	38×49.5×24.5	37.5×41.7×33
P3	43.7×51×41.5	43×60.5×21	43×52.5×35
P4	47×55.3×46.5	49.5×64.5×23.5	46.7×46.3×42.3
M1	57×58×44.5	51.5×62×22.5	55×60×39
M2	57×58×44.5	62×65×31.5	58×60×44
M3	48.6×53.4×48	49×61×38	47.5×56×47

注：长度×宽度×高度(L×W×H)。

下颊齿：无dp1。牙齿外壁的釉质上可见明显和密集的水平细纹。前、后谷的谷底尖锐，其底部距齿根较远，自p2到m3逐渐降低。

p2相当大，双根。下前尖膨大，下前附尖尖锐而前突。下后脊相当粗壮，中央收缩。下次尖和下原尖稍膨大。外沟深。下次脊宽度均匀，其磨蚀面中央形成一个中凹。齿带相当发育，内齿带仅在下后尖处中断；外齿带在前后方向急剧上升，在下原尖外壁处最低，整个外齿带连续，其边缘呈锯齿状。前谷极浅，后谷窄深。

p3的下原脊短粗。下后尖相当膨大而圆润。下内尖小于下后尖，形状呈方形，舌侧平直。齿带非常发育，内齿带在前后方向相当高，在下后尖处下降至最低，并以一齿柱分隔齿带的前、后部分；外齿带前后高，接近牙齿咀嚼面，中间低，接近齿根。外沟呈深的V形。原脊和后脊处的咀嚼面形成深遂的新月形凹陷。前谷宽浅，后谷深凹。

p4与p3在形态上很相似，它的下原尖末梢尖锐，指向舌侧，内侧齿带在下内尖处缺失，前谷较深，下次脊外壁中凹。

m1的齿脊都相当粗大。前谷几乎消失，仅在平面上表现为一非常微弱的凹陷。下后尖大，斜向内后方，其后角较方。后谷窄深，外沟宽深。内侧齿带在前部发达，下后尖舌侧中断，后谷口微弱。下内尖膨大，舌缘平直。下次脊新月型，前缘逐渐变窄。

m2的前叶与m1很相似，前谷圆凹。下后尖的后端相当尖锐，并显著地向后突伸。外沟非常窄深。后叶细长，新月形。下内尖在咀嚼面上较小，但向下逐渐膨大。后谷宽大，谷底有几个突起不高的齿柱。外侧齿带仅发育于前、后角处。

m3窄并短于m2。前谷大而深，后谷宽大。外沟窄深。下后尖末端尖锐而后伸。后叶显著低于前叶。内、外齿带在前角发达，向后减弱。

下颊齿的测量数据见表5。

表5 *Acerorhinus fuguensis* sp. nov. 的下颊齿测量

Table 5 Measurements of lower cheek teeth of *Acerorhinus fuguensis* sp. nov. (mm)

测量项 measures	V 11966	V 11967
p2	35.5×24.5×35	36×24×31
p3	42.5×32×32	41×33×22
p4	45×35×33	44×34×23.5
m1	49×33.5×28	47×31×17.5
m2	55×34×26.7	49.5×30×20
m3	49.5×31×25.5	—×29×25

注：长度×宽度×高度(L×W×H)。

2 对比与讨论

Borissiak(1914)在研究克里米亚半岛的塞瓦斯托波尔三趾马动物群时，定了一个犀类的新种 *Aceratherium zernowi*。随后Borissiak(1915)补充记述该动物群的化石时，又定了一个新变种 *A. zernowi* var. *asiaticum*，他认为这是一种无角的犀类。他同时也指出，*A. zernowi* 的鼻骨变化较大，第一次(1914)记述时的头骨标本曾发现在鼻、额骨联合区有粗糙面的显示，他曾认为这表明这种真犀是有角的，但后来(1915)发现的更好的头骨标本表明鼻骨骨面光滑，在鼻、额骨联合区没有任何粗糙面的显示。然而，鼻骨上沿鼻骨中缝的纵沟在各个标本中的发育情况也不完全一致，因此Borissiak(1915)同意Osborn(1900)的

观点，即在这种犀类中也存在性别上的差异。

Borissiak(1914)建立 *A. zernowi* 新种时的材料较少，但特征仍然相当清楚，即头骨窄，顶面呈鞍形，矢状嵴细窄而高耸；颊齿构造原始；下颌联合部不横向扩展，其宽度比 p2 间的宽度窄；无上门齿，下门齿仅保留巨大的 i2。后来，Borissiak(1915)的补充材料中包括更多保存较好的标本，有 3 个几乎完整的头骨，使对 *A. zernowi* 这个种的了解更加全面。例如，根据新的标本知道这个种的枕面很高而前倾；鼻切迹和眼眶很靠前，前者在 P4 水平，后者在 M1 水平；组成矢状嵴的顶嵴在头骨后部的接近程度在各标本上不完全相同，一般而言两顶嵴在后部相当靠近而形成矢状嵴，但在很老年的标本上却相距较远。上颊齿的原尖和次尖膨大而圆润，在前臼齿上尤其明显；前臼齿的原尖和次尖几乎不发育前、后缢，在臼齿上收缩也相当微弱；小刺不发育，仅呈萌芽状态。

Ringstrom(1942)在研究山西保德犀类化石时，把一些材料归入 *Diceratherium*，即 *D. palaeosinense*，因为他在一个头骨的鼻骨末端两侧发现有粗糙面，推测应是有角附着的痕迹。这些材料的其他特征与 *A. zernowi* 很接近，Ringstron(1942)因此把后者也归入 *Diceratherium* 中。

Kretzoi(1942)认为 *A. zernowi* 不应归入 *Aceratherium* 属中，他为这个种选定了一个新的属名 *Acerorhinus*，并认为它和北美的 *Teleoceros* 关系最近。他同时认为 Ringstrom(1942)的 *D. palaeosinense* 是很特殊的一种犀类，不应归入 *Acerorhinus* 属。Kretzoi(1942)指出的 *Acerorhinus* 的属征包括：头骨短宽；鼻骨短，前端变尖；头骨顶面呈鞍形，枕部高而宽，向前倾；鼻颌切迹后延，牙齿不象 *Chilotherium* 那么特化。此后，这一属名一直未被引用，直到 Heissig(1975)在讨论土耳其安纳托里亚晚第三纪犀类化石时，才将 *Acerorhinus* 作为*Chilotherium* 的一个亚属使用。汤英俊等(1974)、童永生等(1975)、邱铸鼎(1979)、郑绍华(1982)和阎德发(1983)进一步描述和讨论了中国的大唇犀类化石。

邱占祥和阎德发(1982)曾作为亚属确定了 *Acerorhinus* 的特征：顶嵴向后逐渐趋于合并，眶后突前有一很发育的结节，此处为额面最宽处，前颌骨更退缩；鼻骨较宽，两侧缘下垂，顶端可有粗糙面；下颌联合部向两侧扩展较弱，i2 向前上方伸出，不特别加大；颊齿齿冠较低，前尖肋和前附尖褶稍更明显，颊齿比例上较宽短；DP1 单根，上前臼齿比例上较长，内齿带发育；上臼齿反前刺发育稍弱，不伸达中谷出口处；次尖褶发育较明显。Qiu *et al.* (1988)描述了发现于甘肃和政晚中新世地层中的一个大唇犀类的头骨，将这一化石命名为 *Acerorhinus hezhengensis*，重新恢复了 *Acerorhinus* 的属级地位。他们进一步比较了 *Acerorhinus* 和 *Chilotherium* 之间的差别。*Acerorhinus* 的特点包括枕面近一钟形，两侧上角不突出或圆隆，高一般大于宽；鼓后突扁薄，副枕突弱，关节后突粗壮；顶嵴间平面细窄，多形成矢状嵴，最宽不超过 50mm；头骨顶缘鞍形，枕部高；颧弓粗壮，自侧面看很宽，向后宽度变化不大；眼眶上缘与顶面相距约 30mm；自顶面看，眶上突之前存在明显的收缩；鼻骨长而较粗壮，断面透镜状，侧缘下垂；下颌联合部不特别加宽，约与 p2 外缘等宽；左、右 i2 间距小于 40mm；下颌联合部底面中凹浅；雄性 i2 粗壮，多伸向斜上方，断面长椭圆形，长轴更接近垂直方向；颊齿低冠，上颊齿外壁不平，前附尖褶和前尖肋明显，臼齿后尖处向内凹入，反前刺较小，前刺也弱；DP1 和 p2 相对较大。Qiu *et al.*(1988)认为 *Acerorhinus* 和 *Chilotherium* 具有的共同特征在整个Aceratheriinae 亚科中都是十分独特的，与这个亚科中已知的另外两个族——无角犀族 Aceratherini 和远角犀族 Teleocerini 都有显著的区别，因

此建议把 *Acerorhinus* 和 *Chilotherium* 这两个属从 Aceratherini 中分出，单独成立一个大唇犀族 Chilotherini。

Heissig (1989) 也采用了 *Acerorhinus* 作为属而不是亚属的观点，并认为 *Acerorhinus* 这一属开始于 *A. palaeosinensis*，这个种具有相当长的鼻骨和狭窄的头骨。他认为在 *Acerorhinus* 中也存在头骨变宽和鼻颌切迹变深的趋势，i2 的弯曲度变小，下颌联合部从不变宽，鼻颌切迹底部到眼眶的距离很短，面嵴与眼眶的前边缘融合，形成一条几乎垂直的直线。这个属在晚中新世的演化迅速，形成非常复杂的上颊齿构造。按照 Heissig(1989) 的观点，鼻骨前边缘的粗糙面不能解释成附着鼻角的角基。

府谷的材料与 Qiu *et al.* (1988) 定义的 *Acerorhinus* 属的性状完全吻合。根据对 *A. fuguensis* 标本的观察以及其他研究者的论述，可以给出 *Acerorhinus* 属更准确的定义：头骨顶面呈鞍形，其平面形态呈菱形，在眶上突之前有明显的收缩。顶嵴间平面细窄，形成矢状嵴。鼻骨长而粗壮。枕部高。枕面前倾，上部较窄。鼓后突横向扩展成薄板状。鼻颌切迹深。眶上突呈粗厚的结节状。上门齿区强烈退化，上门齿完全缺失。下颌联合部狭窄，其宽度不超过 p2 间距离。下颌水平枝底缘在 p2 前明显上升。i2 粗壮，雄性尤甚。颊齿构造原始，前附尖褶和前尖肋发育，原尖和次尖收缩弱，在前臼齿上表现明显。p2 较大。

到目前为止，被明确地归入 *Acerorhinus* 属的种共有 8 个，包括 *A. zernowi*. *A. tsaidamensis*, *A. palaeosinensis*, *A. intermedius*, *A. cornutus*, *A. hezhengensis* (Qiu *et al.*, 1988), *A. xiaoheensis* (高峰和马波，1997) 和 *A. yuanmouensis* (宗冠福，1998)。

在上述 8 个种中，*A. palaeosinensis*、*A. cornutus* 和 *A. hezhengensis* 的顶嵴之间距离虽然很近，已组成细窄的平面，但并没有合拢形成高耸的矢状嵴，仅从这一点已能明显地与 *A. fuguensis* 区分开来。*A. intermedius* 的个体较小，与 *A. fuguensis* 硕大的尺寸相比差异显著；*A. intermedius* 的 p2 相对很小，实际上与真正的 *Acerorhinus* 并不相同 (见 Heissig, 1972)。*A. xiaoheensis* 和 *A. yuanmouensis* 都产自元谋盆地的晚中新世地层，它们实际上是同一种犀牛，其强烈上翘的鼻骨明显不同于 *Acerorhinus* 平伸而宽大的鼻骨。Cerdeno (1996) 描述的内蒙古通古尔动物群中所谓的 *A. zernowi* 的鼻骨也与元谋的材料相似而不同于塞瓦斯托波尔动物群中真正的 *A. zernowi*。Cerdeno(1996) 认为通古尔动物群的 *A. zernowi* 与 Borissiak(1927) 描述的 Turgai 地区的 *Aceratherium depereti* 很相似，它们之间的区别主要在肢骨的比例上。然而，根据笔者的观察，*A. depereti* 的鼻骨相当细长，鼻颌切迹底部宽大，枕部相当高耸，矢状嵴极细窄，枕部中央形成向前的深凹陷，上前臼齿的原尖未膨大成圆形，这些特征都与 *A. zernowi* 明显不同。*A. fuguensis* 与 *A. zernowi* 和 *A. tsaidamensis* 最为接近，它们都具有细窄而高耸的矢状嵴。但 *A. fuguensis* 强烈向两侧延展的鼓后突、头骨顶面在眶前几乎呈直角的骤然收缩和下门齿略微上翻的内刃与 *A. zernowi* 不同。后者的鼓后突不向外侧伸展，头骨顶面在眶前的收缩较缓，下门齿的内刃几乎呈水平状。*A. fuguensis* 的下颌联合部宽度均匀，而 *A. tsaidamensis* 在 p2 前有一个明显的收缩，使其下颌联合部在此处形成一个细颈。柴达木种还具有 i1 存在的痕迹，而府谷种则完全没有。*A. tsaidamensis* 的头骨顶面形态和鼓后突发育程度也与 *A. zernowi* 相似而不同于 *A. fuguensis* (见 Bohlin, 1937)。

在 *Acerorhinus* 属中，*A. zernowi* 显然是最原始的一个种，它具有圆而膨大的原尖和次尖，在前臼齿上几乎完全没有前、后收缢，上颊齿的构造特别原始，反前刺、前刺和小刺都

很弱。*A. tsaidamensis* 比*A. zernowi* 稍显进步，它的原尖收缩开始加强，颊齿附属构造较为发育，但它也具有一些相当原始的性状，如矢状嵴特别纤细而高耸，下颌联合部极窄甚至收缩。而 *A. fuguensis* 的颊齿附属构造更为发育，尤其是臼齿的反前刺几乎伸达中谷口，同时它的下门齿内刃有上翻的趋势，显示出它在 *Acerorhinus* 中的进步性。如上所述，在 *Acerorhinus* 和 *Chilotherium* 之间存在较大的区别，但 *A. fuguensis* 的发现表明 *Acerorhinus* 属有向 *Chilotherium* 逐渐接近的趋势，这在府谷种下门齿上翻的特点上表现得很明显。

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A NEW SPECIES OF *ACERORHINUS* (PERISSODACTYLA, RHINOCEROTIDAE) FROM THE LATE MIOCENE IN FUGU, SHAANXI, CHINA

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Key words　Fugu, Shaanxi, Late Miocene, Rhinocerotidae

Summary

Laogaochuan, the locality with rich chilothere fossils, is located about 60 km to the northwest of Fugu County seat in Shaanxi Province. In this district, the Neogene strata located above the Mesozoic coal-bearing formation is 52m thick, all the which is underlying the loess. The *Hipparion*-fauna bearing chilothere fossils was collected from the lower and middle beds of the Neogene strata, with an age of 7.4～5.3Ma B. P. based on paleomagnetic dating, i. e. the late Late Miocene (MN12～13) (Xue *et al.*, 1995). A new species of *Acerorhinus* from this locality is described and discussed in this paper.

1　Systematic paleontology

Family Rhinocerotidae Owen, 1845

Subfamily Aceratheriinae Dollo, 1885

Tribe Chilotherini Qiu, Xie et Yan, 1987

Genus *Acerorhinus* Kretzoi, 1942

***Acerorhinus fuguensis* sp. nov.**

(pl. Ⅰ～Ⅱ; tab. 1～5)

Holotype V 11963, an adult skull.

Referred specimens Two skulls and two mandibles.

Etymology Named after "Fugu" County, Shaanxi Province, where the new species is discovered.

Locality and age Wangdaifuliang of Laogaochuan village in Fugu County, Shaanxi Province; the late Late Miocene.

Diagnosis Large size. Posttympanic process is thin, extending outwards and lower than occipital condyle. False external auditory meatus not closed or weakly closed. Nasal notch reaches level before M1. Sagittal crest narrow and high. The position of the orbits is low, with strong supraorbital tubercle and weak postorbital process. Top part of the skull suddenly constricts before the orbit. Praeorbital fossa is well-developed. Symphysis is narrower than the distance between p2. Medial flanges of i2 slightly turn upward. Median valley is closed on the highly worn premolar. Parastyle fold and paracone rib are well-developed. Protocone and hypocone on premolar are not or weakly constricted so that they are very round in shape. Premolars and M3 have no antecrochets practically.

2 Description

Skull In basal view, the foramen magnum is onion-shaped, whereas its upper border is bell-shaped. The end of the posttympanic process is much lower than the lower border of the occipital condyle. The posterior surface of the mastoid process is rough. From the occipital view, the mastoid process is rather slender and constricted in its middle part. In ventral view, the paroccipital process is a long taper shape with three edges. Mastoid and posttympanic processes are like thin flakes. The end of the posttympanic process is close to and slightly fuses with the postglenoid process. In side view, the posttympanic and mastoid processes are at the same level. The occipital crest is smooth but depresses deeply in the middle. The occipital face is rather rough, and its upper part quite concave. There are a series of level crests on the outer margin of the back part of the posttympanic process. The postglenoid process is very strong and temporal condyle is narrow.

The front end of the zygomatic arch extends to level before M2. The zygomatic arch is the widest in level of the boundary of M2 / M3 and the most narrow before the temporal condyle. The arch's posterior-upper corner is strongly prominent. The orbit is small. Its position is low with its upper margin 30mm lower than the frontal face. Postorbital processes are absent on frontal and zygomatic bones but the supraorbital tubercle is well-developed, in which top part of skull is the widest and behind which there is an obvious notch. The projecting front margin of orbit reaches the level of the middle part of the M2. The praeorbital pit is deep. Three large infraorbital foramina with front grooves are found on the maxillary face near the

lower margin of the nasal notch. There is a large infraobital foramen with front groove and a small foramen on the maxillary upper margin. It should be noted that numbers and positions of infraorbital formina in different specimens tend to be irregular in frequency (tab. 1).

The width of the premaxillary bone is much narrower than at the front end of maxillary bone. The front part of premaxillary bone is like a vertical flake.

The bottom of the nasal notch is located at level before the M1. The nasal bone is smooth, with its very wide base and drooping sides. There is a fine groove along the middle suture of nasal bone.

The top part of the skull is flat and a narrow rhomboid in shape which suddenly constricts before reaching the orbit. Strong occipital elevation gives a forward inclined slope on the top part of the skull. The sagittal crest is narrow. Under the parietal cersts, the outer wall of the braincase becomes a steep slope. The palatal face is long and concave, with a fine crest running along the palate middle suture. This crest becomes an obvious tubercle in the center of the sharp V-shaped posterior margin of the palate.

Mandible In side view, the lower margin of the horizontal ramus is slightly curved to the level of cheek tooth row. The mental foramen is situated under the p2. The ascending ramus is far from the m3. The front margin of the ramus forms a wide curved face. In top view, the mandibular symphysis is long, narrow and concave, and its posterior margin reaches the level of the middle of the p3. In a ventral perspective of symphysis there is a shallow depression.

These specimens have only its i2 whose root section is approximately round in shape whereas its crown section forms a somewhat circular triangle. The medial flanges of the i2 slightly turn upward. The angle and distance between the i2 are small.

Upper cheek teeth The DP1 is a large triangular cylinder shape with a single root.

The P2 has developed an inner cingulum, weak parastyle fold and paracone rib. The protocone is large, with a flat lingual margin. The hypocone is larger than the protocone. In much more worn specimen, the median valley closes. Crochet and crista are small and connect each other. The protocone and hypocone have no constriction.

The P3 is similar to the P2, but much larger. The parastyle fold and paracone rib are quite obvious.

The P4 has a slightly larger protocone compared to its hypocone. The protocone has a weak posterior fold near its root, resulting in a wide antecrochet. Crochet and crista are strong and connect each other. The posterior valley closes. The cingulum is incomplete but developed at the lingual margin of protocone.

The M1 has a wide and short parastyle, with a well-developed parastyle fold and

paracone rib. The inner cingulum exists only at the entrance of the median valley. The protocone and hypocone are similar in overall size. The protocone has strongly developed anterior and posterior folds, whereas the hypocone has an anterior fold near its root. The crochet is well-developed, crista is weak or absent, the metastyle is wide and large, and the posterior valley is narrow and deep.

The M2 is similar in size and shape to the M1, but its metaloph is shorter and narrower.

The M3 has a triangular outline with a well-developed front cingulum. There is an isolated pillar found in some M3. The parastyle is sharp and projecting, with parastyle folds and paracone ribs well-developed. The protocone has a weak posterior fold or none at all. The crochet is strongly developed and narrow. There is a vertical ridge on the posterior part of the outer wall of this tooth. The median valley is broad.

Lower cheek teeth In these specimens, the dpl is absent. There are fine level lines on the outer faces of all lower cheek teeth.

The p2 is large and has two roots. Its paraconid extends so greatly that the parastylid becomes sharp and projecting. The hypolophid is wide, and the hypoconid and protoconid are large, each with a deep outer groove. There is a central depression on the worn surface of the hypolophid. The cingulum is well-developed in this tooth.

The p3 has a short and wide protolophid. Its metaconid is very large and circular, and the entoconid is square and slightly smaller than the metaconid. The cingulum is well-developed. The lingual cingulum is divided into two parts by a pillar within its lowest portion under the metaconid. The labial cingulum is not continuous on the exterior wall of the hypolophid and its margins are sawtooth-shaped, and its exterior groove is deeply V-shaped. Worn surfaces of the protolophid and metalophid become deeply crescented depressions.

The p4 is similar to the p3. Its lingual cingulum is absent in the entoconid, and its exterior wall of hypolophid is slightly middle-grooved.

The m1 has very wide protolophid and metalophid. Its metaconid is large, and the exterior groove is wide and deep. The lingual cingulum is not continuous to the level of the metaconid. There is a large entoconid with a flat lingual margin, and crescent-shaped hypolophid is strong.

The m2 is similar to the m1. Its metaconid has a sharp posterior end that is clearly obviously projecting backwards. The exterior groove is very narrow and deep, and there are several low pillars on the bottom of the posterior valley.

The m3 is narrow and obviously shorter in length to the m2. Its exterior groove is narrow and deep, and the trigonid is much lower than the talonid. The lingual cingulum is well-developed and high in the anterior corner, although it drops steeply and becomes discontinues along the exterior wall of the metaconid. There is a low cingulum at the entrance of the posterior valley.

3 Comparison and discussion

Borissiak (1914) described a new species *Aceratherium zernowi* in the Sevastopol *Hipparion* fauna from Crimea, Ukraine. When Rinsgtrom (1924) studied the Rhinocerotidae from Baode, Shanxi, he referred some specimens to *Diceratherium*, i. e. *D. palaeosinense*. The characters of these specimens were similar to *Aceratherium zernowi*, which led Ringstrom to refer it also to *Diceratherium.*

Kretzoi (1942) considered that *Aceratherium zernowi* should not be referred to *Aceratherium*, so he created a new genus *Acerorhinus* for this species thinking that it has the closest relationship with *Teleoceros* in North America. However, Kretzoi considered that *D. palaeosinense* was unique and should not be refereed to *Acerorhinus*. Even though Kretzoi created the genus *Acerorhinus*, this genus has not cited until Heissig (1975) used *Acerorhinus* as a subgenus of *Chilotherium* in discussion of the Neogene Rhinocerotidae from Anatolia, Turkey.

When Qiu *et al.* (1988) described a new species *Acerorhinus hezhengensis* from the Late Miocene in Hezheng, Gansu, they restored *Acerorhinus* as a valid genus. In addition, they suggested that *Acerorhinus* and *Chilotherium* should be removed from the tribe Aceratherini and as a result, established a new tribe Chilotherini.

Until now, eight species have been clearly referred to *Acerorhinus*, including *A. zernowi*. *A. tsaidamensis*, *A. palaeosinensis*, *A. intermedius*, *A. cornutus*, *A. hezhengensis* (Qiu *et al.*, 1988), *A. xiaoheensis* (Gao and Ma, 1997), and *A. yuanmouensis* (Zong, 1998).

Although there are narrow surfaces between parietal crests of *A. palaeosinensis*, *A. cornutus* and *A. hezhengensis*, these surfaces do not become sagittal crests, which are easy to be distinguished from *A. fuguensis*. The size of *A. intermedius* is small, so it is obviously different from the large size of *A. fuguensis*. The p2 of *A. intermedius* is relatively small, which is not the character of the true *Acerorhinus* virtually. *A. xiaoheensis* and *A. yuanmouensis* are collected from the Late Miocene of Yuanmou Basin, and they belong to a same species in fact. Their long and narrow nasal bones strongly rise upward, on the contrary, the large and wide nasal ones of *Acerorhinus* extend horizontally. The nasal bones of "*A. zernowi*" from the Tunggur fauna described by Cerdeno (1996) are similar to these materials from Yuanmou and different from the true *A. zernowi* from Sevastopol. Cerdeno (1996) considered that *A. zernowi* from Tunggur was very similar to *Aceratherium depereti* from Turgai originally described by Borissiak (1927). On the basis of our research, *A. depereti* has a very narrow and long nasal bone, a broad nasal notch base, strong occipital elevation, an extremely narrow sagittal crest, a deep depression in the center of the occipital face, and no circular protocone on the premolars. Together, these are clear differential traits to *A. zernowi*. *A. fuguensis* is the closest to *A. zernowi* and *A.*

tsaidamensis, because all of them have narrow and high sagittal crests. *A. fuguensis* has strongly outextending posttympanic processes, a vertically constrictive skull top before the orbit, and slightly upturning medial flanges, however, these characters are different from those of *A. zernowi*. *A. tsaidamensis* has a constrictive mandibular symphysis with i1, but *A. fuguensis* has an inconstrictive one without i1.

Within the genus *Acerorhinus*, *A. zernowi* is the most primitive species obviously, because it has circular and expanding protocone and hypocone without constriction on the premolar, and weak antecrochets, crochets and cristas on the cheek teeth. *A. tsaidamensis* is slightly more advanced than *A. zernowi*, with its protocone constrictions and relatively developed secondary structures of the cheek teeth. On the other hand, *A. tsaidamensis* still has some very primitive characters, such as a very thin and high sagittal crest, and a narrow, somewhat constrictive mandibular symphysis. The secondary structures on the cheek teeth of *A. fuguensis* are more developed, especially its antecrochets on the molars almost extend to the entrances of the median valleys. Its upturning medial flanges of i2 show its advanced position in the genus *Acerorhinus*. The discovery of *A. fuguensis* indicates that *Acerorhinus* has a tendency to be close to *Chilotherium*. For example, medial flanges of i2 of *A. fuguensis* have begun to turn upward.

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图版说明(Explanations of plates)

图版 I (Plate I)

Acerorhinus fuguensis sp. nov., 保德晚期 (Late Baodean)，府谷老高川 (Laogaochuan, Fugu)

1～2, V 11963, 头骨(skull), 正型(holotype), ×1/4, 1. 侧视(side view), 2. 腹视(ventral view), 3. V 11966, 下颌骨(mandible), 冠视(crown view), ×1/4

图版 II (Plate II)

Acerorhinus fuguensis sp. nov., 保德晚期 (Late Baodean)，府谷老高川(Laogaochuan, Fugu)

1～2, V 11963, 头骨(skull), 正型(holotype), 1. 背视(dorsal view), ×1/4, 2. 后视(occipital view), ×1/3, 3. V 11967, 下颌骨(mandible), 侧视(side view), ×1/4


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